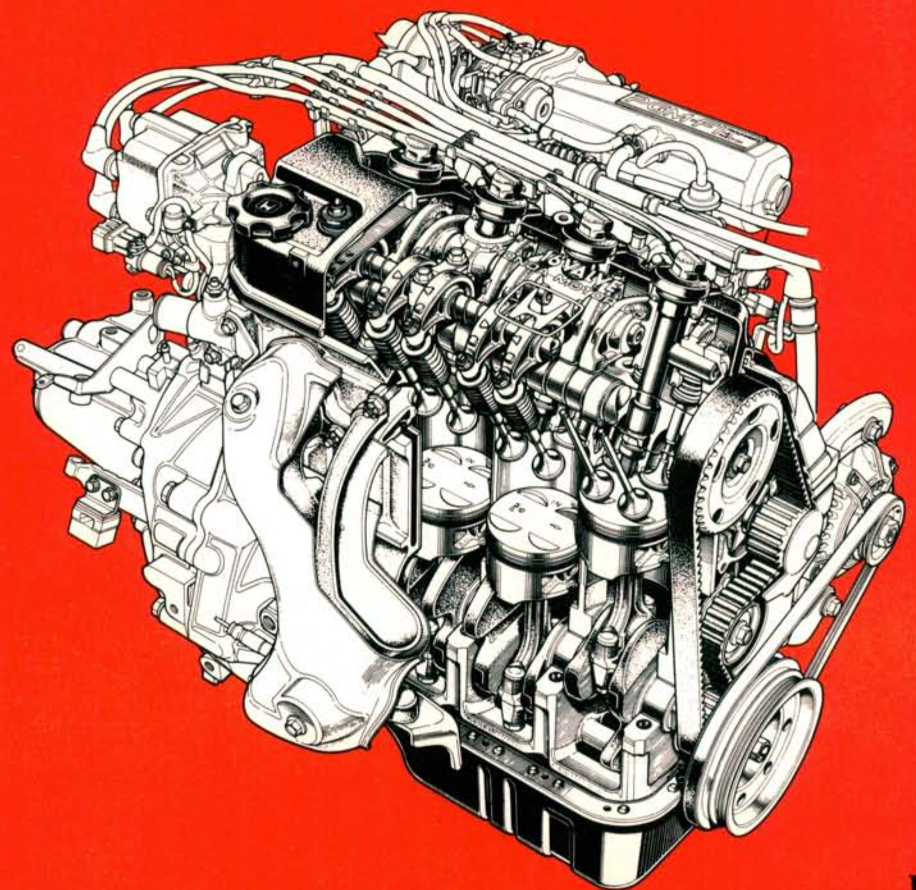
Honda PGM



PART ONE

In 1985, Honda introduced their version of electronic fuel injection, PGM-Fi. It was first available on two models, the Accord SEi and the CRX Si. The following year, PGM-Fi was available on the Accord LXi, Prelude Si, CRX Si, and Civic Si. Currently, PGM-Fi continues to be used on the Accord, Civic Si, CRX Si, CRX HF and the 4WD Wagon.

In 1988, Honda introduced their first dual point, or throttle body injection. It was used only on the base model Civic, CRX and Wagon models. The throttle body and port injection PGM-Fi are similar in some respects, even though the number and placement of injectors is different in the two systems. Fault storage and sensor test values are the same for both systems.

This first part of our coverage of PGM-Fi will start taking you through this system, and show you some of the major components. Our test car is an Accord, far and away the best selling car in the line. We'll do a follow up article with more component descriptions, more theory, and additional test procedures at a later date.

Son of D-Jetronic

Those of you familiar with D-Jetronic fuel injection systems will notice a strong similarity between the theory of PGM-Fi and the theory of manifold pressure control systems used on older European cars.

Volkswagen used a manifold pressure control system on the VW Type III over 20 years ago. Maybe you remember things like trigger points, a barometric pressure sensor, and a throttle switch. You old Porsche/VW, Saab, Volvo, Renault, and Mercedes technicians may try thinking of PGM-Fi as the Son of D-Jetronic—a son that went to college and bought a computer.

The computer in the PGM-Fi is far more sophisticated than the old D-Jet control box, and so are the sensors and actuators. But the air flow meter so common on L-Jetronic and L-Jetronic derivatives is missing. Instead, the manifold pressure sensor sends electrical messages to the ECU, based on changes in manifold pressure.

Let's make a few more comparisons to D-Jetronic that may help clarify system operation.

PGM-Fi	VW D-Jetronic
ECU	Control Box
CYL Sensor	Trigger Points
MAP Sensor	Barometric Pressure Sensor
TW (Coolant Temp Sensor)	Head Sensor
TA (Intake Air Temp Sensor)	Intake Air Sensor
EACV (Electronic Air Control Valve)	Auxiliary Air Regulator
Throttle Angle Sensor	Throttle Valve Switch

The PGM-Fi Electronic Control Unit, or ECU, is responsible for complete engine management. The ECU controls the fuel injection, EGR, idle speed, and the charcoal canister purge control. The ECU also controls the ignition timing on 1988 and later Civic, CRX, and Prelude models.

System Overview

When the ignition switch is turned to the run position, the ECU supplies a ground to the main relay. This signal turns on the fuel pump for two seconds to pressurize the system.

When the engine is cranking or running, the ECU receives a signal from the crank angle sensor. Once the ECU knows the engine is turning, it takes over and supplies the ground to the main relay to keep the fuel pump running.

With the ignition switch in the run position, the main relay also supplies voltage to each fuel injector through a dropping resistor. That means we have power to one side of each injector with the key on. Once the ECU decides how long it wants each injector to stay open, it provides a ground to the other side of the injector. Injector duration is controlled by a ground signal from the ECU.

System Inputs

Some computer programmer gave the ECU a list of instructions about how long it should keep the injectors open at certain engine speeds and manifold air pressures. But the ECU was also given some extra instructions about how to fine tune injector duration for special conditions.

Like other fuel injection systems, these sensors keep track of things like air temperature, coolant temperature, engine speed, and so on. And like many other systems, it does this by sending out a 5 volt scouting party. Since the sensors are variable resistors, the signals sent back by the scouting party will change as temperatures change.

One example is the coolant temperature sensor. As coolant temperature goes up, the resistance of the sensor goes down. Voltage signals are changed by this resistance change, and the ECU keeps track of those changes. The voltage signal returned to the ECU will fall somewhere in the 0.5 to 4.8 volt range.

As you can see, any unwanted resistance in the circuit, or a short to ground could cause some real problems.

Troubleshooting

The ECU has an erasable memory that will store a code until it is erased. This can be done by disconnecting the battery or by removing the proper fuse for 10 seconds or more. Check the manual for the fuse location on the car at hand, unless you want to reset all the radio presets erased by disconnecting the battery.

Retrieve the code and write it on the repair order. Erase the code from memory and test drive the car. This test drive is a very important step. If you can't duplicate the code after a test drive, any circuit tests you perform will come out normal.

If the code is intermittent, run voltage drop tests in the affected circuit. These tests may lead you to some iffy connections with borderline high resistance. Check all the circuit connections to make sure they are clean and tight.

We were informed time and again that individual component failures are a rarity in this system. Most of the problems have been related to loose or corroded harness connections or bad grounds.

Don't Make Things Worse

It is possible to make things worse. If you get careless or use the wrong test equipment during testing, you can turn a hang nail into a compound fracture in a hurry.

- A DVOM with a 10 meg ohm impedance is the most important testing tool you can own for troubleshooting this system.
- Whenever possible, backprobe with a thin tester lead or paper clip. Never insert a tester lead into the open end of a connector or you'll spread it and cause a bad connection.
- Never use a test light. Old time test lights using 0.3 amps or more can allow enough current to flow to give you false readings, or even damage sensitive components.

• Never apply voltage to any circuit. If a test light lets too much current flow, you can imagine what a 12-volt jumper wire will do. You can scorch almost any sensor in the system with this approach.

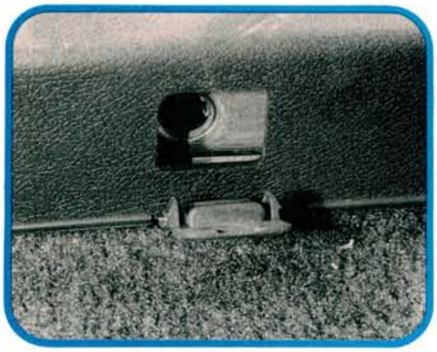
There are no codes for the Check Engine Light, Canister Purge Control Solenoid, Main Relay, or Fuel Injectors (except for a code 16 on 1988 and later Civics and Preludes). If the check engine light comes on and there are no codes stored, or if you get a code not listed in this chart, the ECU is faulty.

There is one other exception to this rule. In 1988, the Accord LX-i system was changed to include a code 17 to indicate a problem in the Vehicle Speed Sensor circuit. The change was made late enough in the production run that the service manual did not include this information. Normally, a code 17 would tell you that the ECU was bad, since other cars did not check the speed sensor.

—By Ralph Birnbaum

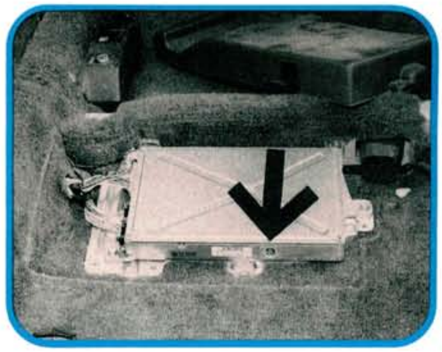
PGM-Fi Fault Codes

Code	Inputs
1 and 2	Oxygen Sensors A and B
3 and 5	MAP Sensor
6	TW Sensor
7	Throttle Angle Sensor
8	Crank Angle Sensor (TDC)
9	Crank Angle Sensor (CYL)
10	TA Sensor
12	EGR Lift Sensor
13	PA Sensor
17	Vehicle Speed Sensor
Code	**Outputs**
14	EACV



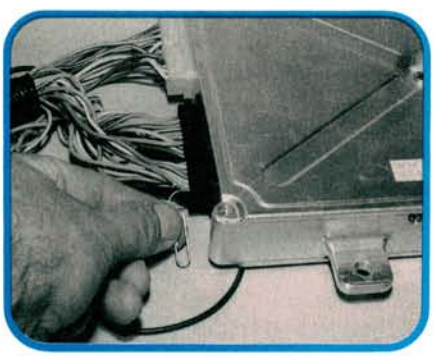
1

The ECU is under the driver side seat in all Accords. Move the seat forward and drop this small trap door to view the LED and check for fault codes. The ECU is under the passenger floorboard on Civics and Preludes. On 1986-87 Preludes, remove the ash tray in the left quarter panel trim to view the LED. On 1985-87 Civics, it's under the passenger seat.



2

You'll need to get at the ECU for testing. We removed the driver seat. Note the LED location (arrow). If the dash warning light flashed at the customer last week, but then stopped, a code will still be entered in the system and the LED will flash until the problem is corrected and the light is reset.



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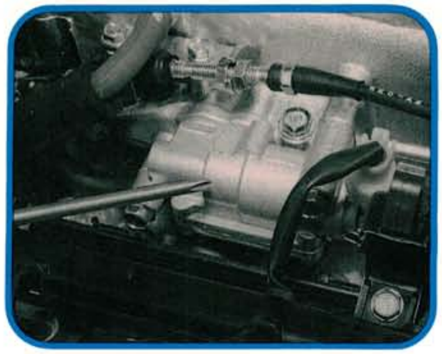
Some say that it's impossible to test the system without this pricey Honda test harness, but you can backprobe the connectors with a paper clip and get the same results. Probe gently so you don't damage anything. A DVOM with a 10 meg ohm impedance is basic issue here, however.

4

The main relay controls power to the injectors and to the fuel pump. You'll find it near the upper left side of the dash, near the fuse panel. Terminal numbers and test values: 1-Battery Hot; 2-Main Ground; 3-To ECU; 4-To Starter Switch; 5-To Ignition Switch; 7-To Fuel Pump; 8-To Ground.

5

The fuel pressure regulator is used to keep the fuel pressure difference constant between the fuel rail and the intake manifold. Fuel pressure should be approximately 2.5 kg/cm² (35 PSI) at idle. Test the regulator by removing the vacuum hose during a pressure test to see if fuel pressure goes up by about 10 PSI.



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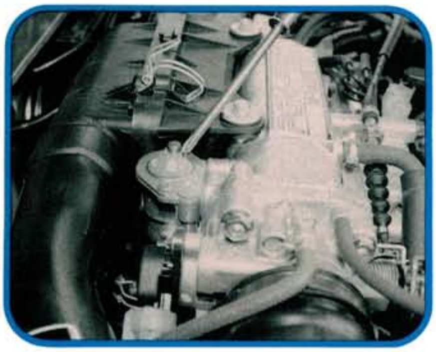
The EACV on this Accord is an ECU controlled air-bypass valve that maintains a constant idle speed when normal engine loads like headlights and air conditioning are turned on. It also provides a certain amount of fast idle when the coolant temperature is below 50 degrees C (122 F).



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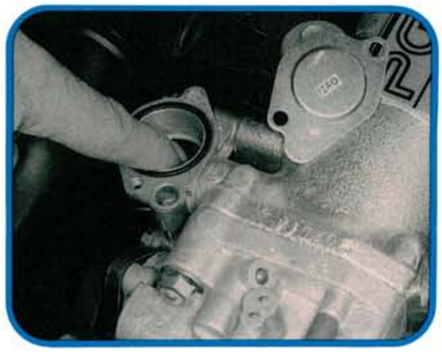
When the engine is really cold, a wax element in the fast idle control valve lets even more by-pass air raise cold engine idle to prevent stalling. To check the valve, remove the cover and place your finger over the brass part of the valve. You should feel suction with the engine idling at coolant temperatures below 30 degrees C (86 degrees F).



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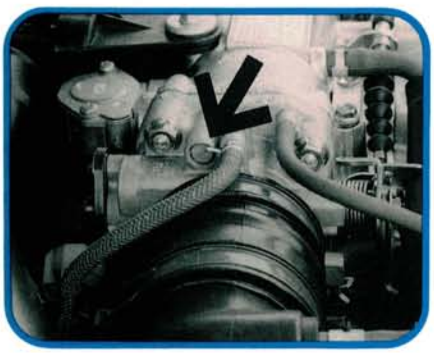
Some of the shop manuals were confusing about where to feel for vacuum at the fast idle control valve. There is a port open to the manifold, and the brass colored valve. Place your finger over the brass valve, not the port to the manifold which is always open anyhow.



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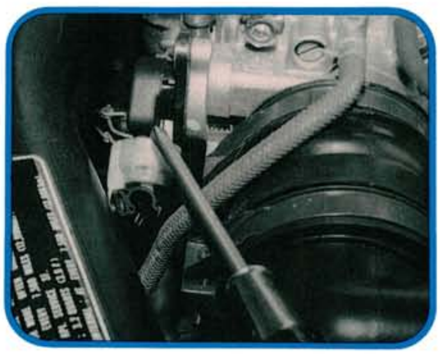
Use this screw to set warm, base idle to 650 $\pm$50 RPM with the EACV disconnected, the steering wheel straight ahead, and all electrical accessories turned off. Reconnect the EACV and remove the clock 10 amp fuse for 10 seconds to erase the fault code you may have set in the ECU by disconnecting the EACV.



10

Test the throttle angle sensor. Disconnect the sensor connector and check for 5 volt reference voltage at the YEL/WHT wire (key on). Reconnect the sensor and check between ECU connectors C7 and C12. Voltage should rise evenly as the throttle is opened, from an idle reading of 0.5 volt to a wide-open throttle reading of 4.5 volts.

11

The MAP sensor is located in the black box in the right rear area of the engine compartment. A 5 flash fault code for the MAP probably means a broken number 21 vacuum hose. A code 3 is probably electrical. The MAP sensor voltage should be about 3 volts with the engine off, key on, and about 1 volt at idle.

12

Each of the vacuum hoses is numbered. If you do get a code 5, indicating a vacuum source problem in the MAP sensor circuit, follow the 21 hose to the tee below the MAP. Make sure the last guy who checked the MAP vacuum remembered to replace this plug in the short test hose outlet below the tee connection.

13

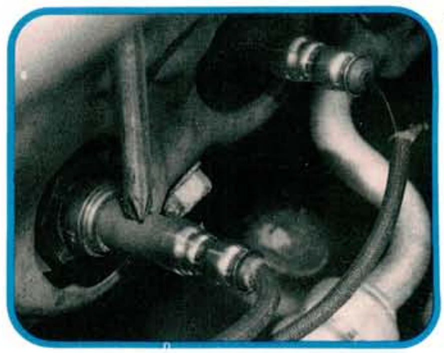
The Atmospheric Pressure (PA) sensor is located on the right lower corner of the dash. The PA sensor helps to compensate for changes in atmospheric pressure such as a change in altitude. The PA and MAP sensor voltages should be about the same (about 3 volts) with the key on and engine not running.

14

The TA sensor is found in the intake plenum. Since air temperature affects air density, it's very important that the ECU know about manifold air temperature. Resistance should be about 4 K ohms at 0 degrees C, and decrease to about 1 K ohms as the air temperature increases to 40 degrees C.

15

The coolant temperature (TW sensor) is right next to the cooling fan switch. Careful. Connectors are color coded but will interchange. As the coolant temperature goes up, the TW resistance value goes down. Run the engine until the cooling fan cycles. Check for 200-400 ohms across the TW terminals at this temperature.



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Our Accord has two oxygen sensors. A quick test of the sensors is to connect your voltmeter between a disconnected O^2 sensor lead and ground. Look for about 0.6 volt at 5000 RPM. The voltage should drop below 0.4 volt when the throttle is released. A code 1 or 2 LED signal at the ECU will send you to a bad sensor.